

C. Felton Prairie Aggregate Resources

1. Summary of the Felton Prairie Aggregate Resource Evaluation

In 1999 DNR conducted an aggregate resource evaluation on 735 acres of county and state owned land within the Felton Prairie study area. The purpose of the aggregate evaluation was to obtain more information on the quantity and quality of aggregate in those selected areas. The area to be evaluated was divided into four smaller areas (Fig. 27):

Area 1: Clay County gravel pit and county land north of it

Area 2: South of the Clay County gravel pit

Area 3: Bicentennial Prairie SNA

Area 4: West of active gravel pits and Area 1

Data collected from nine electrical resistivity transects was used to target potential drill hole locations. Then a rotasonic drilling rig was used to collect core samples from 27 drill holes (Fig. 27) ranging from 25 to 145 feet deep. Core samples were retained and later sampled for quality analysis by the Minnesota Department of Transportation. Aggregate volumes for some areas were estimated using a computer model. Drill hole locations, drill logs, quality analysis, and volumes were summarized in the Aggregate Resource Evaluation (DNR, 2000) delivered to the Felton Prairie Stewardship Committee in May, 2000. The committee used the aggregate evaluation data as the basis for further interpretation on following pages.

In addition to collecting core samples, investigators estimated an approximate water table elevation at each drill hole. This information was used by scientists from the DNR Division of Waters who analyzed the hydro-geologic conditions supporting the calcareous fens west of the drilling sites in the study area (Fig. 26).

The aggregate resource evaluation identified two deposits: a deep primary deposit of high quality material and a shallow secondary deposit of discontinuous beach ridges. The primary deposit reaches a depth of 100' east of the Clay County gravel pit. The overburden material ranges from medium sand to silts and clay. The volume and quality for each area is summarized below and in table 3:

Area 1: This area (Fig. 27) is estimated to have 24 million cubic yards of sand and gravel and contains the primary deposit. The evaluation further subdivided this area into A (county pit), B (north of the county pit), and C (remainder).

A- 5.9 million cubic yards: nearly all of the material above the water table in the county pit has been mined. What remains will require methods and equipment suitable for working below the water table.

B- 2.9 million cubic yards, 0.9 million cubic yards above the water table, 2 million cubic yards below: overburden thickness is 2' or less making it cost effective to mine. The deposit thickness ranges from 68-93' and the quality of the upper portion is very good and meets concrete specifications. The lower portion has some shale mixed in with sand.

C- 15.3 million cubic yards, 3.4 million above the water table and 11.9 million below: overburden ranges from 10-20'. The deposit thickness ranges from 0-83' with good quality above the water and shale mixed with sand below the water.

Area 2: Not enough core samples were drilled in this area to estimate the quantity of the deposit. What was drilled had deep overburden ranging from 29-55'. The deposit quality is good, however, and ranges from 0-57' thick.

Area 3: No quantity was calculated for this area because the singular drill sample contained no aggregate. The resistivity profiles north of this drill hole (#7) indicated significant gravel and led to additional profiles taken in August 2000 which showed that 40 acres in the northwest portion has high gravel potential. Thirty acres in the southwest corner also

showed significant aggregate but excessive overburden for the current market. The remaining 90 acres were silt and sand (MN DNR, 2000). No volumes were calculated for this area.

Area 4: Deposit is surficial, irregular and poorly graded.

AREA	1A	1B	1C	2	3	4
Over-burden	0	<2'	10-20'	29-55'	NA	0-9'
Aggregate thickness	55-65'	68-93'	0-83'	0-57'	0-100+'	<10'
Total Volume (cy)	5,900,000	2,900,000	15,300,000	NA	NA	NA
Notes	good quality	good quality	good quality	good quality	No sample	Uneven quality

Table 3: Table summarizes DNR interpretation of the data by area. Volume shown in cubic yards.

Table 4 lists the analysis of core samples taken from each drill hole. These data include the depth of overburden, depth of aggregate, and additional interpretation developed by the stewardship committee. This interpretation includes an aggregate to overburden ratio derived by dividing the depth of the aggregate by the depth of overburden. The ratio value represents the depth of aggregate per foot of overburden. This is mapped in Figure 29. Under current market conditions, operators typically need a resource depth of 10' and a ratio of 10 or better to mine profitably. The drill hole symbols in Figure 29 represent the quality of the material sampled from that location. Members of the stewardship committee representing the gravel industry analyzed the sample data for each of the drill holes and rated them for quality on a scale of 1 to 10, 1 being poor and 10 being good. Their evaluation was based on the percentage passing sieve # 4 and is shown in column 5 of Table 4. That value was then used as a multiplier ($10=1$, $5=0.5$) to obtain a singular value for quality and quantity comparison. It is important to note that these values were developed by the stewardship committee for mapping and comparison purposes only and do not convey commercial value or scientific accuracy.

Felton Aggregate Resource Evaluation

Drill Hole #	Deposit Thickness	Overburden	Gravel to Overburden Ratio (1)	Quality Rating (2)	Ratio x Quality Coefficient (3)
1	55	0	55.0	9	49.50
2	54	0	54.0	9	48.60
3	65	0	65.0	10	65.00
4	63	2	31.5	10	31.50
5	57	29	2.0	6	1.18
6	0	55	0.0	2	0.00
7	103	2	51.5	3	15.45
8	54	47	1.2	10	1.15
9	0	55	0.0	0	0.00
10	9	7	1.3	2	0.26
11	68	2	34.0	10	34.00
12	61	15	4.1	7	2.85
13	83	2	41.5	9	37.35
14	77	1	77.0	10	77.00
15	72	19	3.8	8	3.03
16	45	20	2.3	8	1.80
17	64	19	3.4	10	3.37
18	82	2	41.0	8	32.80
19	77	2	38.5	9	34.65
20	93	2	46.5	6	27.90
21	16	1	16.0	5	8.00
22	11	2	5.5	7	3.85
23	42	10	4.2	5	2.10
24	0	65	0.0	0	0.00
25	1	5	5.0	2	1.00
26	6	9	0.7	3	0.20
27	0	40	0.0	0	0.00

Table 4: Drill hole data for roto sonic drill core samples

(1) Gravel to overburden ratio derived by dividing the aggregate depth by overburden. Value listed equals the number of feet of aggregate per foot of overburden.

(2) Committee's quality rating is based on the percentage of material passing a #4 screen. 10 = <50%, 9 = 55-60%, 8 = 60-65%, 7 = 65-70%, 6 = 70-75%, 5 = 75-80%, and others as deemed appropriate.

(3) This value represents the relative value of the deposit samples. The quality rating (2) is used as a multiplier e.g. 10 = 1.0, 8 = 0.8, etc. for the overburden ratio.

2. Resistivity Study of Bicentennial Prairie

At the request of the committee, DNR completed additional resistivity profiles along transects in Bicentennial Prairie shown in Figure 27. These were taken because core samples from drill hole numbers 7 and 20 showed significant aggregate and low overburden. This additional evaluation indicated a significant sand and gravel deposit; however, the deposit quality and ratio of sand to larger particles cannot be determined without local roto sonic drilling. The study suggests a significant deposit on the west side of Bicentennial Prairie with little overburden in the north but increasing in depth to the south. The study concludes that the northwest 40 acres has high aggregate potential with little overburden (MN DNR, 2000). The stewardship committee's contours in Figure 28 also indicate increasing overburden to the south.

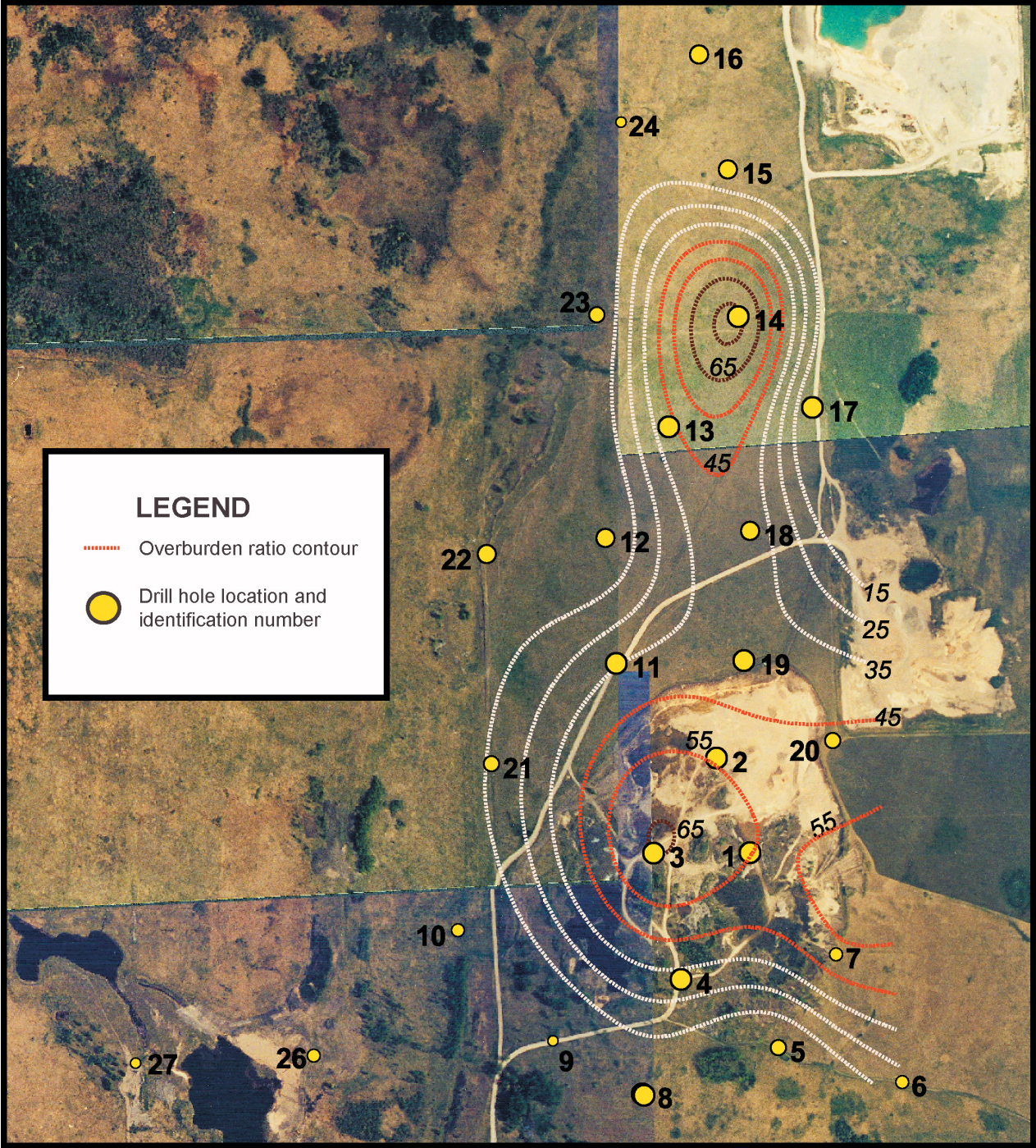


Figure 28: Contours representing the desirability (aggregate:overburden ratio) of the aggregate resources on Clay County property.